

MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS-1963-A

(1)

WHATELY, MASSACHUSETTS

È

NORTHAMPTON RESERVOIR
(UPPER DAM)

MA 00521

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

Copy available to RefiC does not permit fully legible reproduction





DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DTIC FILE COPY AUGUST 1978

Approved for public releases

Distribution Unlimited

85 5 28 0 4 2

UNCLASSIFIED

SECURITY CAMSSIETCATION OF THIS PAGE (When Dote Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
MA 00521	2. GOVT ACCESSION NO		
TITLE (and Substitle)		5. TYPE OF REPORT & PERIOD COVERED	
Northampton Reservoir (Upper Dam)		INSPECTION REPORT	
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		6. PERFORMING ORG. REPORT NUMBER	
AUTHOR(s)		B. CONTRACT OR GRANT NUMBER(#)	
U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION			
PERFORMING ORGANIZATION NAME AND ADD	DRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS		12. REPORT DATE August 1978	
NEW ENGLAND DIVISION, NEDED		13. NUMBER OF PAGES	
124 TRAPELO ROAD, WALTHAM, MA.		. 63	
MONITORING AGENCY NAME & ADDRESSIS	ilterent from Controlling Office)	15. SECURITY CLASS. (of this report)	
		UNCLASSIFIED	
		184. DECLASSIFICATION DOWNGRADING	

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, If different from Report)

IS. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

13. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin Whately, Massachusetts West Brook

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a 940 ft. long earth embankment dam with a concrete spillway. The visual inspection did not disclose any findings that indicate an immediate unsafe codition. It is recommended that the areas of erosion both on the upstream and downstream faces where the abutments and embankment interface be repaired. Surface water in these areas should be redirected to prevent future erosion.

DD 1 JAN 73 1473 EDITION OF 1 NOV ST IS DESOLETE

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.



DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

424 TRAPELO ROAD

WALTHAM, MASSACHUSETTS 02154

REPLY TO ATTENTION OF:

NEDED

Honorable Michael S. Dukakis Governor of the Commonwealth of Massachusetts State House Boston, Massachusetts 02133 Accession For

NTIS GRAMI
DTIC TAB
Unannounced
Justification

By
Distribution/
Availability Codes

Avail and/or
Dist
Special

Dear Governor Dukakis:

I am forwarding to you a copy of the Northampton Reservoir (Upper Dam) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, the City of Northampton, c/o Board of Public Works - Water Division, 237 Prospect Street, Northampton, Massachusetts 01060.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely yours,

Incl
As stated

JOHN P. CHANDLER
Colonel, Corps of Engineers
Bivision Engineer

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA. 00521

Name of Dam: Northampton Reservoir (Upper Dam)

Town: Whately

County and State: Franklin County, Massachusetts

Stream: West Brook

Date of Inspection: May 25, 1978

This dam is a 940 foot long earth embankment dam with a concrete spillway. The dam was designed in the mid 1960's and Constructed in 1970. The engineering data made available were a set of construction drawings and specifications. These were furnished by the City of Northampton, owners of the dam.

The visual inspection did not disclose any findings that indicate an immediate unsafe condition. Based on size and hazard classification in accordance with Corps guidelines, the test flood is the Probable Maximum Flood. However, the dam's spill-way will not pass the PMF without overtopping.

It is recommended that the areas of erosion both on the upstream and downstream faces where the abutments and embankment interface be repaired. Surface water in these areas should be redirected to prevent future erosion. The riprap on the upstream face should be extended to the dam's crest. The water exiting from the toe and core wall drains should be directed to a control channel and weir where the flow can be periodically measured. This dam has a thin concrete core wall and, although the dam is in earthquake zone 2 and not normally requiring earthquake evaluation

Northampton Upper Dam

the effects of earthquake shaking on the integrity of the core wall should be investigated.

The 20" capped pipe running beneath the dam to the down-stream toe should be uncapped and extended to the lower reservoir. This will prevent the potential of a pressurized pipe (should the outlet gate be left open) from bursting and undermining the dam.

Although the spillway can not discharge the test flood without overtopping the dam, the spillway capacity is comparatively large. Because of the hydrologic and safety relationships between this dam and the lower reservoir, it is necessary that future hydrologic studies concerning spillway capacities at either project should simultaneously encompass studies for both projects.

These recommendations are not of an urgent nature but should be implemented within a period of 2 to 4 years.



Ronald # Gleeney

Ronald H. Cheney, P.E. Associate

Hayden, Harding & Buchanan, Inc. Boston, Massachusetts

This Phase I Inspection Report on Northampton Reservoir (Upper Dam) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the <u>Recommended Guidelines</u> for <u>Safety Inspection</u> of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman Chief, Foundation and Materials Branch Engineering Division

FRED J. RAVINS, Jr., Member Chief, Design Branch

Engineering Division

SAUL COOPER, Member Chief, Water Control Branch **Engineering Division**

APPROVAL RECOMMENDED:

Chief, Engineering Division

SEP 1 5 1978

PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external

conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof.

Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

	PAGE
LETTER OF TRANSMITTAL	
BRIEF ASSESSMENT	
REVIEW BOARD SIGNATURE SHEET	
PREFACE	
TABLE OF CONTENTS	
OVERVIEW PHOTOS	
LOCATION MAP	
REPORT	
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	2
1.3 Pertinent Data	4
SECTION 2 - ENGINEERING DATA	8
2.1 Design	8
2.2 Construction	8
2.3 Operation	8
2.4 Evaluation	8
SECTION 3 - VISUAL INSPECTION	10
3.1 Findings	10
3.2 Evaluations	14

•	PAGE
SECTION 4 - OPERATIONAL PROCEDURES	15
4.1 Procedure	15
4.2 Maintenance of Dam	15
4.3 Maintenance of Operating Facilities	15
4.4 Description of Warning System	15
4.5 Evaluation	15
SECTION 5 - HYDRAULIC/HYDROLOGICAL	16
5.1 Evaluation of Features	16
SECTION 6 - STRUCTURAL STABILITY	17
6.1 Evaluation of Structural Stability	17
SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND	19
REMEDIAL MEASURES	
7.1 Dam Assessment	19
7.2 Recommendations	19
7.3 Remedial Measures	19
APPENDICES	
Appendix A - Visual Inspection Check List	
Appendix B - Engineering Data - Past Inspection	
Reports-Plans	

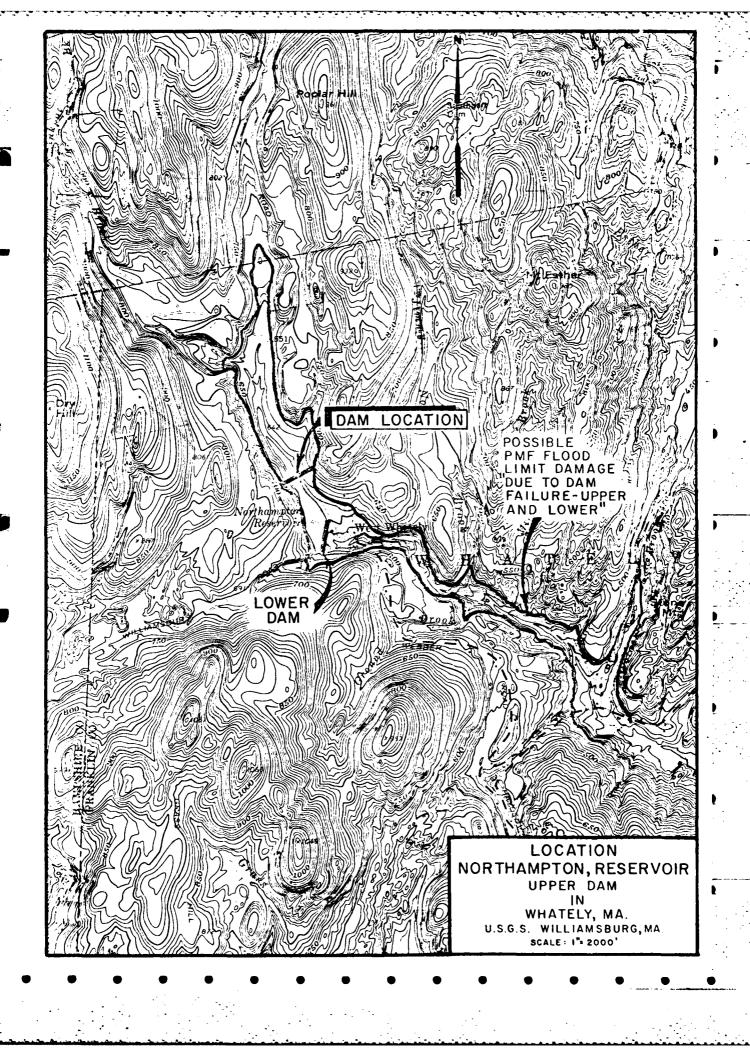
Appendix C - Photographs

Appendix D - Computations-Drainage Area

the National Inventory of Dams

Appendix E - Information as Contained in





PHASE I NATIONAL DAM INSPECTION PROGRAM NORTHAMPTON RESERVOIR (UPPER DAM)

SECTION 1 PROJECT INFORMATION

1.1 General

a. Authority.

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Hayden, Harding & Buchanan, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Hayden, Harding & Buchanan, Inc. under a letter of May 3, 1978, from Mr. Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0307 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

- (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
- (3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Northampton Reservoir Upper Dam is located in the Town of Whately in Franklin County, Massachusetts, just upstream of Northampton Reservoir Lower Dam.

b. Dam and Appurtenances

The dam is a 940' long, 80' high earth embankment structure having a riprap upstream face sloping at 2:1 and a turf covered downstream face sloping at 2:1. Located within the center of the dam is a 2' wide concrete core wall. The top of the dam embankment section has a width of 20 feet. Located adjacent to the embankment on the eastern side is a 66' wide 35' high concrete spillway, having a vertical upstream face and downstream face sloping at approximately 3:4. Located within the upstream embankment approximately 70' north of the top of the dike is a gate structure. This structure has a 20" diameter low level intake pipe and two intermediate level intake gates.

Two 20" diameter D.I. pipes exit from the bottom. One pipe empties into the lower reservoir directly below this site.

The other pipe is capped just beyond the toe of the dam.

c. Classification

The dam can be classified by size as intermediate due to its hydraulic height of 80 feet and its storage capacity of 2865 a.f.

d. Hazard Classification

The dam has a high hazard potential for loss of life should a complete failure occur. Approximately 15 habitable structures could be damaged by the dam's failure.

e. Ownership

The dam is owned by the City of Northampton and has always been part of their water supply system.

f. Operation

The dam is maintained and operated by the Board of Public Works - Water Division located at 237 Prospect Street, Northampton, Massachusetts. Mr. Leon Murray is the Superintendent of the Water Division (tel. 413-584-1401).

g. Purpose of Dam

The dam's purpose is water supply. Water is drawn into the intake structure flowing through the 20" diameter D.I. discharge pipe and empties into the lower reservoir directly below the dam.

h. Design and Construction History

The dam was designed by the engineering firm of Whitman & Howard, Inc., Wellesley, Massachusetts. The construction was completed in 1970 and no major repair program has been instituted since its completion.

1.3 Pertinent Data

a. Drainage Area

Drainage Area (2897 acres - 4.52 s.m.) is comprised of wooded, rolling hills, containing several drainage paths. The ', main drainage path is the Avery Brook. It's length is 3.6 miles and has a drop in elevation of 550 feet. Steep changes in the brooks elevation are intercepted by "flat" areas in several locations.

There are very few homes within the area and roads appear to be unimproved dirt roads.

Below the dam is the area known as West Whately. There are several buildings and homes located within 1000 feet of the dam. These buildings are located within 400' of the discharge stream known as West Brook. The brook flows for about a mile before any buildings come within 200 feet of the stream bed. Beyond that, development is scattered and not close to the brook.

b. Discharge at Dam Site

This dam has two 20 inch diameter D.I. pipes exiting from the intake structure at Inv. El. 624.17. One pipe discharges directly into the lower reservoir. The other pipe is capped just below the toe of the dam. Other than the active 20 inch pipe there is no other means of dewatering this site.

The dam was constucted in 1970 and no record of maximum impoundment or spillway discharge is known. Area residents have witnessed flows of approximately 12 to 18 inches maximum above the spillway crest.

The spillway is ungated and has an approximate capacity of 3320 c.f.s. (735 c.s.m.) at elevation 680.5.

- c. Elevation (ft. above MSL)
 - (1) PMF surcharge 681.0
 - (2) Top Dam 680.5
 - (3) Water Supply Pool varies 675.0
 - (4) Spillway crest (gated)-nongated 675.0
 - (5) Upstream portal invert diversion tunnelno diversion tunnel
 - (6) Streambed at centerline of dam-600.±
 - (7) Maximum tailwater-flows through spillway channel directly into lower reservoir elev. 601.±
- d. Reservoir
 - (1) Length of Water Supply Pool 4000'±
 - (2) Length of PMF Pool 5000'
- e. Storage (acre-feet)
 - (1) Water Supply Pool 2460
 - (2) Top of Dam 2820
 - (3) PMF Surcharge 4367
- f. Reservoir Surface (acres)
 - (1) Water Supply Pool 79
 - (2) Top Dam 90
 - (3) PMF Pool 91

g. Dam

- (1) Type-Gravity straight earth embankment
- (2) Length-940'
- (3) Height-90' (structural includes cutoff)
- (4) Top Width-20'
- (5) Side Slopes-2:1 riprap U.S., 2:1 turfed D.S.
- (6) Zoning -none
- (7) Impervious Core -Concrete Wall
- (8) Cutoff -Core wall set on rock and till.
- (9) Grout curtain -none
- i. Spillway
 - (1) Type -Broad crest, concrete ogee
 - (2) Length of weir-66'
 - (3) Crest elevation-675.0
 - (4) Gates -none
 - (5) U/S Channel -none
 - (6) D/S Channel -Concrete paved for 60'

j. Regulating Outlets

The regulating outlets for this facility consists of the two 20" dia. D.I. outlet pipes from the intake structure. As described previously only one of these pipes is active, the other being capped. The active pipe flows directly into the lower reservoir. The Inv. elevation for both of these pipes is 624.17.

The intakes consist of a lower level 20" dia. D.I. pipe at Inv. El. 629.17 and two 16" dia wall openings at Inv. Elevations 649.33 and 664.33.

All of the intakes and outlets are controlled by their own manually operated gate.

The intake structure is a reinforced concrete tower with inside dimensions of 7'-0" X 6'-0". It is founded on ledge at elevation $620.0\pm$ and the top slab is at elevation 680.0.

SECTION 2 ENGINEERING DATA

2.1 Design

This dam was designed by the Engineering firm of Whitman and Howard, Wellesly, Ma. The Construction drawings are dated 1965 with additional test borings added in 1969.

A complete set of construction drawings and Specifications was furnished by the City of Northampton. Hydraulic and Stability Calculations have been requested of Whitman and Howard. However, they are having difficulty locating these in their files and as of the date of this report have not been found.

2.2 Construction

Construction was completed in 1970 and as far as is known the in place dam is in agreement with the Contract drawings.

2.3 Operation

There are no formal records of operational procedures for this dam. The Caretaker and Superintendent of the water division indicated that no major problems have occured since the dam has been put into operation.

2.4 Evaluation

a. Availability

Construction drawings and Specifications were made available by the City. Hydraulic calculations have not been found as of this date.

b. Adequacy

It is felt that the construction drawings and the specifications are adequate for a Phase I report regarding structural stability. The original hydraulic and stability calculations along with any original soils reports have not been found as of the date of this report. Therefore the adequacy of this dam must be based on the limited data supplied along with the visual inspection and hydrologic and hydraulic assumptions.

c. Validity

The visual inspection of this facility showed no reason to question the validity of the information supplied. The possible exception is with the top of the riprap referred to later in this report.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. General

The phase I inspection of this dam was made on May 25, 1978. The water in the reservoir was running over the Spillway approximately one inch. All Items on the upstream slope including the slope were therefore inspected from the water surface elevation up.

b. Dam

Visual inspection of the embankment showed no signs of distress.

Upstream Slope

Only the upper 6 ft. of the U.S. slope was visible at the time of inspection. The upstream slope has been protected with riprap which is in good condition. The riprap protection stops about 3 ft. below the crest of the dam. (See photo \$3*) Design drawings indicate that the riprap should have been carried to the crest elevation of 680.00 ft. It is not known if the crest elevation has been raised or the riprap stopped at a lower elevation than intended. Design drawings indicate full reservoir elevation at 675.0 which would mean about two feet of protected freeboard exists under full reservoir height. There is no sign of erosion above the top of the riprap and this condition does not pose an immediate safety hazard to the dam at this time, however, it is recommended that additional riprap be added to protect the entire upstream slope to the crest.

*See Appendix C for this and all subsequent photos.

Northampton Upper Dam

There has been erosion of the contact of the upstream slope of the dam and the left abutment due to surface water runoff. (See photo 1 .) This condition does not pose an immediate threat to the safety of the dam, but provisions should be made to collect surface runoff and prevent continued erosion.

Crest

The crest of the dam has no pavement. No evidence of erosion or cracking of the embankment was observed. The abutment of the service bridge appeared to be in good alignment.

Downstream Slope

The face of the downstream slope was traversed along four lines, (1) along the crest, (2) at approximate elevation 665.0, (3) along the berm (elev. 640.0) and (4) along the toe.

The slope is in good condition with an excellent turf and grass cover. There were occasional rodent holes in the surface.

No seepage or damp areas were observed along the toe.

There is an area of minor surface sloughing 40 feet left of the left spillway wing wall. (See photo 4). The area is approximately 18 ft. square with its upper boundary at the intersection of the crest and the slope. The topography within this area is hummocky with reliefs of about 2 ft.

There is a surface erosion channel at the contact of the left abutment and the downstream slope. The lower end of this erosion channel which intersect the left spillway wall, has been filled with rock cleaned out of the spillway apron in an effort

to minimize further erosion. In some areas the erosion is quite deep as can be seen in photo 6. This surface erosion is not an immediate threat to the safety of the dam but it is recommended that this condition be corrected soon.

Similar erosion has occureed on the right abutment at the embankment contact. This erosion is not as severe as on the left abutment but maintenance measures should be taken to eliminate this surface erosion.

A 6" diameter toe drain was installed in the downstream slope. Two drain pipes, one leading from each abutment exit into the area of the original brook channel. Both of these drains are flowing small amounts of clear water. The drain from the right abutment is shown in photo 9.

A third drain exits into the old brook channel at the dam toe. This drain leads from a horizontal drain along the base of the concrete core wall. This drain which is submerged is flowing a large amount of clear water. Disturbance to the surface of the pool into which this drain discharges is shown in photo 9. It is recommended that a control channel and weir be constructed to permit measurement of seepage from the three drain pipes.

c. Appurtenant Structures

The intake structure was inspected above the water surface. The concrete was found to be in good condition with no cracks, spalls or rusted reinforcement evident. The service bridge of steel trusses and galvanized grating was found to be

in good condition with only minor rust showing.

The spillway with its concrete walls and concrete paved outlet channel is in good condition. The channel walls do have som shrinkage and temperature cracks at approximate mid points between construction joints. With the exception of one joint which appears to have been constructed out of alignment by approximately one inch, all joints are in align. Some minor spalls exist at the expansion joints. The pavement of the outlet channel is good with only minor areas of surface erosion (1" max. depth).

The spillway has one large spall approximately triangular in shape 5 feet long and 10 inches wide at is base. This spall is 0" deep at its apex and 2"± deep at its base. The spall is located at the base of the spillway approximately 4 ft. off the £. Also where the upstream walls abut the spillway proper, there are cracks and spalls. These are the same cracks referred to in the state's inspection reports. The plans tend to confirm that this is properly caused by the spillway extending to rock while the walls are placed on soil foundation well above the rock. These cracks are shown in photo no.13.

d. Reservoir Area

The reservoir area consists of wooded rolling hills.

An indepth description of the drainage area is given in section

1.3a of this report. The amount of silation within the reservoir is unknown.

e. Downstream Channel

Three recent landslides have occurred in the spillway discharge channel. These landslides are shown in photos 7 and 8. They present no immediate safety hazard to the dam but should be repaired soon to prevent continued erosion and further landsliding.

3.2 Evaluation

Visual examination indicates no immediate safety problems, however, erosion at the abutment/embankment contact areas due to surface water runoff should be stopped by redirecting the runoff or providing a suitably designed drainage way.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures

The water from this reservoir is used to supply the City of Northampton. The normal operating procedure is with the gate on the 20" dia. pipe which feeds water to the lower reservoir open allowing water to flow into the lower reservoir.

4.2 Maintenance of Dam

The City normally cuts the down stream slope once a year and inspects for animal burrows, filling those holes which are found.

4.3 Maintenance of Operating Facility

All manually operated gates for the intake structure and the outlet pipes are operated once a year by the City.

4.4 Description of Warning Systems

There are no warning systems associated with this dam.

4.5 Evaluation

The normal procedure of cutting turf and operating all the gates at least once a year appears adequate for this facility. This dam, however, should be inspected yearly by qualified personnel who can identify any areas of concern which could in time lead to serious deficiencies.

SECTION 5 HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

As of this report, the hydraulic computations for this dam have not been provided. Therefore the required test flood was developed as noted in "d" below.

b. Experience Data

Maximum impoundments and spillway flows for this dam are unknown. Residents of the area indicate the maximum height of water observed over the spillway to be 12 to 18 inches.

c. Visual Observations

Visual observations of the drainage area and general vicinity of the dam show them to be in general agreement with area U.S.G.S. map. Description of the drainage areas is given in Section 1.3 of this report.

d. Overtopping Potential

This dam carries an intermediate classification for size with a high hazard potential and as such should be capable of passing a PMF. This test flood was computed by determining the watershed drainage area from USGS maps in combination with Corps discharge guide curves. A PMF inflow of 8500 cfs was developed and results in a discharge of 7550 cfs. This discharge would result in the dam being overtopped by about 0.5 ft. (El. 681). With the reservoir level at 680.5, the spillway discharge is 3320 cfs (735 csm), which is equivalent to about a ½ PMF.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The visual inspection did not disclose any apparent stability problems.

b. Design and Construction Data

Design drawings and construction specifications exist and indicate that the dam is a homogeneous embankment consisting of "compacted pervious fill" with a concrete core wall. The embankment is founded on glacial till with a cut-off trench extending into the till on the right and to bedrock on the left side of the dam. The concrete core wall extends to the base of the cut-off trench. Both the upstream and downstream slopes of the embankment were designed on a 2H to 1V slope. A 10 ft wide berm exists 12 ft above the toe on the downstream and upstream slopes.

c. Operating Records

No operating records were made available.

d. Post-construction Changes

There are no known post-construction changes to the dam embankment.

e. Seismic Stability

The dam is located in Seismic Zone 2 according to U.S. Corps of Engineers guidelines and normally it would be assumed that there is no hazard from earthquake loading provided

static stability conditions are satisfactory and conventional safety margins exist. However, because the dam relies on a thin concrete core wall as a water barrier and the embankment is a homogeneous pervious fill, it is recommended that the owner engage a knowledgeable consulting engineer to evaluate the possibility of the occurance of damage to the core wall during earthquake shaking.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Conditions

The visual inspection did not disclose any findings that indicate an immediate unsafe condition.

b. Adequacy

The information available is such that a Phase I level investigation can be performed adequately.

c. Urgency

The recommendations presented in Sections 7.2 and 7.3 should be implemented by the owner within two to four years.

d. Necessity of Additional Investigations

The findings of the visual inspection do not warrant an additional investigation.

7.2 Recommendations

The owner should engage a qualified consultant to evaluate the effect of earthquake shaking on the integrity of the concrete core wall.

7.3 Remedial Measures

Although this dam is basically in good condition it is considered important that the following items be accomplished.

a. Alternatives

It is recognized that the dam will not pass the test flood without overtopping the dam. The spillway capacity is

2

comparatively large, however, because it could discharge a flood equivalent to a ½ PMF. Because of the hydrologic and safety relationships between the upper and lower water supply reservoirs, it is necessary that future hydrologic studies concerning spillway capacities at either project simultaneously encompass studies for both projects. Refer to the Northampton Reservoir Lower Dam, MA. 00520, Phase I Inspection Report.

b. Operation and Maintenance Procedures

- (1) Repair surface erosion channels at abutment/embank-ment contacts upstream and downstream.
- (2) Redirect and collect surface water along abutments to prevent further erosion.
- (3) Riprap should be added to the upstream slope above the existing riprap to the crest elevation.
- (4) A control channel and weir should be constructed to permit periodic measurement of flow from the three drainage pipes in the embankment.
- (5) The 20 inch diameter capped pipe extending beyond the toe of the dam should be uncapped and extended to the lower reservoir. In lieu of extending the pipe, an adequately designed and riprapped channel could be provided. As it now stands, this pipe could be surcharged by a 50 foot head if the outlet gate at the intake structure is opened. Should the pipe

C

burst while under this 50 foot head, serious undermining of the dam could ensue.

- (6) This dam should be inspected annually by qualified personnel who can identify areas of concern which could, in time, lead to serious deficiencies.
- (7) Around the clock surveillance should be provided during periods of unusually heavy precipitation. In addition, the owner should develop a formal system for warning downstream residents in case of emergency.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST PARTY ORGANIZATION

PROJECT Northhampton Wately Complex Upper Dam	DATE May 25, 1978	
	TIME. 10:30 am	
	WEATHER Cloudy 620F	
	W.S. ELEV. 675.1 U.SDN.S	
DADTY.		
PARTY:		
1. Ron Cheney	- 6	
2. Dan LaGatta	- 7	• •
3Craig Nehring	- 8.	
₹	9	
5	- 10,	
	•	
PROJECT FEATURE	INSPECTED BY REMARKS	
1. Embankment Dam	Dan LaGatta	
2. Outlet Channel	Dan LaGatta	
3. Intake Structure & Control Structure	Ron Cheney	
4. Spillway	Ron Cheney	
5. Service Bridge	Ron Cheney	
6.		
7		1
8		
9		•
10		

PERIODIC INSPECTION CHECK LIST DATE May 25, 1978 PROJECT Northampton Wately Complex PROJECT FEATURE Upper Dam NAME D.P. LaGatta DISCIPLINE Geotechnical Engineer NAME R.H. Cheney Structural Engineer . AREA EVALUATED CONDITIONS DAM EMBANKMENT Crest Elevation 680.5 One inch above spillway crest Current Pool Elevation Unknown Maximum Impoundment to Date None observed Surface Cracks No pavement Pavement Condition None observed Movement or Settlement of Crest None observed Lateral Movement No misalignment observed Vertical Alignment No misalignment observed Horizontal Alignment Condition at Abutment and at Concrete Left abutment has surface water erosion on upstream side Structures Indications of Movement of Structural None observed Items on Slopes None observed Trespassing on Slopes Left abutment has surface erosion at Sloughing or Erosion of Slopes or upstream and downstream contact with Abutments embankment No failures observed Rock Slope Protection - Riprap Failures None observed Unusual Movement or Cracking at or near Toes Unusual Embankment or Downstream None observed Seepage None observed Piping or Boils Downstream toe near right abutment Foundation Drainage Features None observed Toe Drains None Instrumentation System

1	CTION CHECK LIST
PROJECT Northampton Wately Complex	DATE May 25, 1978
PROJECT FEATURE Upper Dam	NAME D. P. LaGatta
DISCIPLINE Geotechnical Engineer Structural Engineer	NAME R.H. Cheney
AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	This facility has no approach channel.
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	·
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	None
·	

3

Í

ď

PROJECT FEATURE Upper Dam	NAME D.P. LaGatta
DISCIPLINE Geotechnical Engineer	NAME R.H. Cheney
Structural Engineer	· · · · · · · · · · · · · · · · · · ·
AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	Control tower and intake structure are one and the same
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spallin g	None observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	No misalignment observed
Unusual Seepage or Leaks in Gate Chamber	
Cracks	None observed
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	All gates are manually operated.
Air Vents	City checks gates for operational ability once a year.
Float Wells	Only operational outlet is 20" dia. D.I.
Crane Hoist	pipe which flows into lower reservoir.
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPEC	TION CHECK EIST
PROJECT Northampton Wately Complex	DATE <u>May 25, 1978</u>
PROJECT FEATURE Upper Dam	NAME D.P. LaGatta
DISCIPLINE Geotechnical Engineer	NAME R.H. Cheney
Structural Engineer	
AREA EVALUATED	CONDITIONS
UTLET WORKS - TRANSITION AND CONDUIT	There is no transition and conduit.
General Condition of Concrete	20" dia. D.I. pipe outlet only.
Rust or Staining on Concrete	·
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSP	ECTION CHECK LIST
PROJECT Northampton Wately Complex	DATE May 25, 1978
PROJECT FEATURE Upper Dam	NAME D.P. LaGatta
DISCIPLINE Geotechnical Engineer	NAME R.H. Cheney
Structural Engineer	· · · · · · · · · · · · · · · · · · ·
AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	No outlet structure.
General Condition of Concrete	Pipe discharges directly into lower reservoir.
Rust or Staining	Stone varying in size from 4" to 2't covers end of pipe.
Spalling	Most of pipe outlet is actually
Erosion or Cavitation	covered.
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	
Channel	
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	See Section 3.1 of Report for description of three slides along channel walls.
	·

í

PERIODIC INSPEC	CTION CHECK LIST	
PROJECT Northampton Wately Complex	DATEMay 25, 1978	
PROJECT FEATURE Upper Dam	NAME D.P. LaGatta	
DISCIPLINE Geotechnical Engineer	NAME R.H. Cheney	
Structural Engineer	· · · · · · · · · · · · · · · · · · ·	
AREA EVALUATED	CONDITIONS	
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	CONDITIONS	
a. Approach Channel	This facility has no approach channel.	
General Condition		
Loose Rock Overhanging Channel		
Trees Overhanging Channel		
Floor of Approach Channel		
b. Weir and Training Walls		
General Condition of Concrete	Good	
Rust or Staining	None observed	
Spalling	*Small area base of spillway off center	
Any Visible Reinforcing	line. None observed	
Any Seepage or Efflorescence	Small amount at joints.	
Drain Holes	None	
c. Discharge Channel		
General Condition	Good	
Loose Rock Overhanging Channel	None	
Trees Overhanging Channel	None	
Floor of Channel	Rock strewn	
Other Obstructions	None .	
	*Some spalling at joints where upstream	
	walls abut spillway.	

E

PROJECT FEATURE Upper Dam	NAMED.P. LaGatta	
	NAME R.H. Cheney	
	NAME Rone Cheney	
Structural Engineer		
AREA EVALUATED	CONDITIONS	
OUTLET WORKS - SERVICE BRIDGE		
a. Super Structure		•
Bearings	Good	
Anchor Bolts	Good	
Bridge Seat	Good	-
Longitudinal Members	Good	
Under Side of Deck	Galv. grating - good	
Secondary Bracing	Good	•
Deck	Galv. grating - good	
Drainage System		
Railings	Painted steel - good	•
Expansion Joints	None - slotted holes in bearings	
Paint	Some rust - not serious at this time	
b. Abutment and Piers		<u> </u>
General Condition of Concrete	Good	
Alignment of Abutment	Good	
Approach to Bridge	None	
Condition of Seat and Backwall	One spalled area approximately 6" long in backwall.	•
		•

APPENDIX B

- 1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS
- 2. PAST INSPECTION REPORTS
- 3. PLANS AND DETAILS

LIST OF AVAILABLE ENGINEERING DATA

1) Set of Construction Drawings.

- 2) Set of Construction Specifications. Location: City of Northampton, Board of Public Works Water Division. 237 Prospect Street, Northampton, Massachusetts.
- 3) Construction Drawings are also on Micro-film at the Engineering office of Whitman & Howard. 45 Williams Street, Wellesly, Massachusetts.

To this point in time, Whitman & Howard has not been able to find design calculations.



The Commonwealth of Massachusetts

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR. DIVISION OF WATERWAYS

ty of Northampton Board of Public Works h ter Division 2 7 Prospect Street Northampton, Ma. AMITN: Mr. Leon Murray

100 Nashua Street Boston 02114

February 25, 1977

Inspection Dam #2-6-337-3 Northampton's West Whately Reservoir Upper Dam Whately, Ma.

bear Sir:

, an Engineer from the Massachusetts Department May 26, 1976 of Public Works made a visual inspection of the above dam. Cur records indi-. If this information cate the owner to be the City of Northampton is incorrect will you please notify this office.

The inspection was made in accordance with the provisions of Chapter 253 of the Massachusetts General Laws as amended (Dams Safety Act). Chapter 705 of the Acts of 1975 transferred the jurisdiction of the so-called "Dams Safety Program" to the Commissioner of the Department of Environmental Quality Engineering.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

See "Remarks & Recommendations" on reverse side

We call these conditions to your attention before they become serious and more expensive to correct. With any correspondence please include the number of the Dam as indicated above.

John J. Hannon, P.E.

Chief Engineer

Francis J. Hoey Russell Salls

File

REMARKS AND RECOMMENDATIONS

DAM #2-6-337-3 MAY 26, 1976

Several animal burrows were noted in the downstream slope and toe of slope. Erocom of spillway channel bed at lower end of outlet is becoming more noticeable. In area is rough paved with boulders which are becoming misplaced by water action to the not appear to pose any problem to safety of dam at present.

The settlement cracks between wingwalls and abutment walls of overflow spillway tid in last inspection have been repaired as has the face of spillway dropwall. he wingwalls appear to have stabilized now and only hairline cracks were noted.

Considerable seepage flows were noted in the stone paving or riprap along toe of dam at how much of this is surface storm water draining off was difficult to determine. We seepage drainpipe outletting on the westerly toe of slope had a strong flow of it remerging and a small amount of fine deposits were noted in brook bed directly clow outlet end of pipe.

It would seem advisable for the Water Department to maintain a log of this seepage low as a reference check for any possible unwarranted future increase in flow which ould be indicative of a problem in the dam's structure.

INSPECTION REPORT - DAMS AND RESERVOIRS

) LOCATION:				
City/Town	Uhately County	Franklin•	Dam No2	2-6-337-3
Name of Dam	Morthampton's West Whately R Mass. Rect.	escrvoir - Upper		.•
Topo Sheet No.		27,600 E 270	, ann	.•
Inspected by:	Harold T. Shumway , On M	Date av 26. 1976 . Last		on_11/29/73_
OWNER/S: As o	of May 26, 1976			
per: Assessor	Reg. of Deeds,	Prev. Insp. x, I	er. Contac	t x
	orthampton Public Works, Water Division	. 237 Prospect St	Northamote	ın. Mass.
Name	St. & No.	City/Town	State	Tel. No.
2. Name	St. & No.	City/Town	State	Tel. No.
3. Name	St. & No.	City/Town	State	Tel. No.
abs Mr. Leon Murs	f any) e.g. superintendent, sentee owner, appointed by maray, er Division, 237 Prospect St	ulti owners.		
Name	St. & No.	City/Town	State	Tel. No.
	Pictures Taken <u>Nona</u> . Ske Where <u>In office files of Nor</u>			
DEGREE OF HAZE	ARD: (if dam should fail com	pletely)*		•
1. Mino	or	3. Severe x		•
2. Mode	erate	4. Disastrous		•
and	orox. 750 million gallons im at least 10 homes and 5 hig may change as land use chang	hway bridges would b	os affected	

OUTLETS:	OUTLET CONTROLS AND DRAWDOWN
No. 1 I	Easterly end of dam - concrete overflow chute spillway- Location and Type: 66' wide x 5' high with 32' high conc. ages dropwall.
(Controls None, TYPE:
į	Automatic . Manual . Operative Yes , No
C	Comments: Minor spalling of face of dropwall.
	Location and Type: 66' northerly of dike - conc. gate house - 2 ea. 20" dia ductile iron pipes.
(Controls yes , Type: Screw lift pate valves.
	Automatic . Manual x . Operative Yes x , No
	Comments: Noe of these pipes is a feed pipe to lower reservoir. Location and Type: 50'+ north of gatehouse - 20" dia. low intake pipe.
(Controls Yes , Type: Screw lift nate valve.
1	Automatic . Manual X . Operative Yes X , No .
(Comments: Operable per Water Division personnel.
	om present Yes X , No . Operative Yes X , No . ts: See No. 3 above.
DAM UPST	REAM FACE: Slope 2:1 , Depth Water at Dam 45' to 50' .
	al: Turf Brush & Trees Rock fill MasonryWood
Other_	Stone payed slope.
	ion: 1. Good x . 3. Major Repairs
	2. Minor Repairs 4. Urgent Repairs .
Commen	ts:
DVM DOMM	STREAM FACE: Slope 2:1 variable .
Materi	al: Turf x . Brush & Trees . Rock Fill . Wasonry . Wood
Other_	•
	ion: 1. Good
Condit	
Condit	2. Minor Repairs X . M. Urgent Repairs .

Hoight Ab	ara Norme	T Tist	eí: 0	E+	&								
Width													
			Height										-•
Condition										-			
	2.	Minor	Repairs_		•	4.	Urgent	: Rep	airs_		•		
Comments:	Wingwal	1 crac	cks and fac	a_of_dr	opwall	L_bay	a been	rep	aired	sin	ca_1	ast	in-
	spectio	n of 1	1/29/33.	Structu	re_apr	nears	good	at pi	esen	<u>t_tir</u>	na.		·
-	•					····							
TER LEVEL	AT TIME	OF IN	SPECTION:	5_	_Ft. A	bove_		•	Belov	, <u>X</u>		•	
			F.L. Pri										
			•	-		*							
Other													
				- to to									· •
OtherNormal Fre			5 Ft	to to						····			· •
Normal Fre	eeboard_		5 Ft.	to to							****		•
Normal Fre	eeboard	CIES N	5 Ft.		pofo	dam.							•
Normal From MARY OF I	DEFICIENC	CIES N Brush	5 Ft.	cment	p of c	dam.	1				De.		
Normal From MARY OF I	DEFICIENC	CIES N Brush	5 Ft. OTED:) on Embani	cment	None	foun	i i on d	owns	traam	slog			
Mormal From MARY OF I Growth (The Animal Burn Damage to	DEFICIENCE and crows and Slopes of	CIES N Brush I Wash or Top	5 Ft. OTED:) on Embanl outs 5 1800 of Dam Se	cment	None holes	foun foun	i i on d soma	owns area	tream s of	slor	se f	urf (cove
MMARY OF I Growth (To Animal Bur Damage to Cracked or	DEFICIENCE and crows and Slopes of Damageo	CIES N Brush I Wash or Top	5 Ft OTED:) on Embanlouts 5 woo of Dam Se	cment_ dchuck e burro surface	None holes	found found found ove -	i on d some repai	o:::ns area: red	tream s of	slor soar:	se fo	urf_d	<u>ov</u> e:
Normal Free MARY OF I Growth (Tree Animal Bur Damage to Cracked or Evidence of	DEFICIENCE and crows and Slopes of Seepage	CIES N Brush Nash or Top Maso	5 Ft OTED:) on Embanlouts 5 1000 of Dam Se nry Minor	cment dchyck e byrro surface page fl	None holes crack	foundam. foundamente foundame	i soma repai	o:::ns area: red ne p:	tream s of area aved	slor soars of w	se fo	urf alls lope	ove:
MARY OF I Growth (Tr Animal Bur Damage to Cracked or Evidence of	DEFICIENCE and crows and Slopes of Damageo of Seepag	CIES N Brush d Wash or Top d Maso	5 Ft OTED:) on Embanl outs 5 woo of Dam Se nry Minor Several see	cment	None holes crack	foundary fou	i d on d some repai	owns areas red ne p	tream s of area aved	slor soars of w	se for	urf dalls.	onver
MOTION FOR MOTION MARY OF I Growth (To Animal Bur Damage to Cracked or Evidence of Evidence of Leaks	DEFICIENCE and crows and Slopes of Damageo of Seepag	CIES N Brush Nash or Top Naso SeS	5 Ft OTED:) on Emband outs 5 woo of Dam Se nry Minor Several see	cment_ dchuck e burro surface page fl None	None holes crack	foundam. foundaments foundame	i on d some repai	owns area red ne p	tream s of area aved	slor spar: of w	ingw	urf u	
Normal Free MARY OF I Growth (Tree Animal Bur Damage to Cracked or Evidence of Evidence of Leaks Erosion E	DEFICIENCE rees and rrows and Slopes of Damageo of Seepagof Piping	CIES N Brush I Wash or Top I Maso	5 Ft OTED:) on Emband outs 5 woo of Dam Se nry Minor Several see	cment dchuck e burro surface page fl None None	None holes crack	foundam. foundaments foundame	i on d some repai in sto	owns area red ne p	treams of area	slor spars of w	se fo	urf d	enver
Normal Free MMARY OF I Growth (Tree Animal Bur Damage to Cracked or Evidence of Evidence of Leaks Erosion E	DEFICIENCE rees and rrows and Slopes of Damageo of Seepagof Piping	CIES N Brush I Wash or Top I Maso	5 Ft OTED:) on Emband outs 5 woo of Dam Se nry Minor Several see	cment dchuck e burro surface page fl None None	None holes crack	foundam. foundaments foundame	i on d some repai in sto	owns area red ne p	treams of area	slor spars of w	se fo	urf d	enver

1.2.

OVERALL CONDITION:

1.	Safe
2.	Minor repairs needed x
3.	Conditionally safe - major repairs needed
4.	Unsafe•
5.	Reservoir impoundment no longer exists (explain)
	Recommend removal from inspection list



REMARKS AND RECOMMENDATIONS: (Fully Explain)

Mr. Craig Nehring, work crew foreman of the Northampton Water Dept., was present during this inspection and all problems noted in report were discussed with him.

Several animal burrows were noted in the downstream slope and toe of slope. Erosion of spillway channel bed at lower end of outlet is becoming more noticeable. This area is rough paved with boulders which are becoming misplaced by water action but do not appear to pose any problem to safety of dam at present.

The settlement cracks between wingwalls and abutment walls of overflow spillway noted in last inspection have been repaired as has the face of spillway dropwall. The wingwalls appear to have stabilized now and only hairline cracks were noted.

Considerable seepage flows were noted in the stone paving or riprap along toe of dam but how much of this is surface storm water draining off was difficult to determine. The seepage drainpipe outletting on the westerly toe of slope had a strong flow of water emerging and a small amount of fines deposits were noted in brook bed directly below outlet end of pipe.

It would seem advisable for the Water Dept. to maintain a log of this seepage flow as a reference check for any possible unwarranted future increase in flow which would be indicative of a problem in the dam's structure.

At the present time this dam appears to be safe.

December 21, 1973 :

Leon Murray, Superintendent Water Division Board of Public Works 237 Prospect Street Northampton, Massachusetts 01050

Ra: Inspection-Dam # 2-6-337-3
Whately
Northampton's Whately
Reservoir-Upper Dam

Doar Mr. Murray:

On November 29, 1973, an engineer from the Massachusetts Department of Public Works inspected the above dam, owned by the City of Northampton.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

1. The upstream wingwalls of the chute spillway are cracked away from the abutment joints by as much as 3/4 of an inch at the top surface, with the possibility that the northerly ends may have settled slightly.

2. A crack in the face of the spillway droppeall, about 6 feet above the follow, with wetness of the surface indicates continuous scepage.

The above conditions should be investigated and repaired as necessary. We call these conditions to your attention now, before they become serious and more expensive to correct.

Very truly yours,

LPA:moy

LICI)

cc: F.J. HOEY

R. SALIS

Tred. C. Schweln

Degrity Chiof Engineer

INSPECTION REPORT - DAMS AND RESERVOIRS

)	LOCATION:
	Cixty/Town Whately . County Franklin . Dam No. 2-6-337-3 .
	Name of Dam Northampton's West Whately Reservoir - Upper . Mass. Rect.
	Topo Sheet No. 11A . Coordinates: N 527,600 , E 279,900 .
	Inspected by: Harold T. Shumway , On Nov. 29, 1973 . Last Inspection 1970 .
)	OWNER/S: As of November, 1972
	per: Assessors X , Reg. of Deeds , Prev. Insp. , Per. Contact x .
	City of Northampton, 1. Board of Public Works, Water Division, 237 Prospect Street, Northampton, Ma. 0106
	Name St. & No. City/Town State Tel. No.
	Name St. & No. City/Town State Tel. No.
	3
_	Name St. & No. City/Town State Tel. No.
•	CARETALER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.
	Leon Murray, Superintendent of Water Division, 237 Prospect Street, Northampton, Ma. 01060
	Name St. & No. City/Torm State Tel. No.
)	DATA:
	No. of Pictures Taken None . Sketches See description of Dam. Plans, Where In Water Division Offices .
	Tasio, more and an arrangement of the second
•	DEGREE OF HAZARD: (if dam should fail completely)*
	1. Minor 3. Severe X
	2. Moderate 4. Disastrous
•	Comments: At least 10 homes and 5 bridges would be affected .
	*This rating may change as land use changes (future development).

OUTLETS: OUT	PLET CONTROLS AND DRAWDOWN
No. 1 Loca	Easterly end dam - concrete overflow chute spillway - ution and Type: 66' W. x 5' H. with 32' H. concrete ogee dropwall .
Cont	crols No , TYPE:
Auto	omatic Manual Operative Yes, No
Corr	ments: This is an emergency overflow spillway
No. 2 Loca	ation and Type: 66' northerly of dike - concrete gatehouse .
Conf	crols X , Type: 2 - 20" M.J. ductile iron pipes with screw lift , gate valves.
	gate valves. omatic . Manual x '. Operative Yes x , No .
	nents: One of these pipes is a feed pipe to lower reservoir
	ation and Type: 50' north of gatehouse - low intake pipe - 20" dia.
	crols X , Type: Screw lift gate valve
	omatic . Manual X . Operative Yes X , No .
	menta:
	oresent Yes X , No . Operative Yes X , No
DAM UPSTREAL	A FACE: Slope 2:1 , Depth Water at Dam 45' to 50' .
	Turf Brush & Trees Rock fill Masonry Wood
	Stone paving .
	l. Good X . 3. Major Repairs .
	2. Minor Repairs 4. Urgent Repairs .
Comments	Stone paving appears stable - concrete gatehouse appears sound.
Ourrent of .	biolic paving appears stated denotes a factorious appears backets
	•
DAM DOWNSTRE	TAM FACE: Slope 2:1 variable
Material:	Turf X . Brush & Trees . Rock Fill . Masonry . Wood .
Other	•
	: 1. Good . 3. Major Repairs .
Condition	
Condition	2. Minor Repairs X . 4. Urgent Repairs .

ENERGENCY SPILLMAY: Available Yes . Needed .	
Height Above Normal Water 7 Ft. Water level at time of	f inspection
Width 66 Ft. Height 5 Ft. Material Conc	rete
Condition: 1. Good 3. Major Repair	·s
2. Minor Repairs X 4. Urgent Repai	rs•
Comments: Both upstream wingwalls have cracked at union with a	spillway abutment
and appear to have settled - pulling away from abute 3/4 of an inch at top level.	ment about .
O. WATER LEVEL AT TIME OF INSPECTION: 12 Ft. Above Be	
Top Dam X F.L. Principal Spillway	•
Other	
Normal Freeboard 5 Ft.	
SUMMARY OF DEFICIENCIES NOTED: Growth (Trees and Brush) on Embankment None	•
Animal Burrows and Washouts Yes. Two animal burrows on downst	tream slope
Damage to Slopes or Top of Dam None except animal burrows	•
Cracked or Damaged Masonry East spillway abut wingwall cracked in spillway dropwall.	- minute cracks .
Evidence of Seepage Yes. Heavy seepage at toe of slope in area	of 20" dia. feed.
pipe to lower reservoir. Some seepage noted spillway dropwall.	through concrete
Leaks None Noted	*
Erosion Minor erosion if spillway runoff channel	•
Trash and/or Debris Impeding Flow None	•
Clogged or Blocked Spillway None	·•
Other	·

_
(-)
!12.1
<u> </u>

OVERALL CONDITION:

Τ.	Saie	•	
2.	Minor repairs needed	X	e.

3.	Conditionally	safe -	major	repairs	needed	
/•	TOLIGIE TECHNICATED	2020		TOPALLO	1100000	•

4. Unsafe_____.

5. Reservoir impoundment no longer exists (explain)

Recommend removal from inspection list_______.

13.

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This is a relatively new dam - built in 1970. The grade and alignment of earthen dike, which has a two foot wide concrete core to within two feet of top is good. The stone paved upstream slope appears stable. The downstream slope is well turfed over and appears stable. On westerly end of dike, it was noted that downstream slope had eroded from surface water and had been stone riprapped to prevent further erosion.

Both of upstream wingwalls of chute spillway were cracked away from abutment joints from $\frac{1}{2}$ to 3/4 of an inch at top surface. It would appear that northerly ends of walls may have settled slightly. A crack was noted in face of spillway dropwall about 6 feet above floor level. There was a wetness of surface around area of this crack indicating continuous seepage. Minor erosion of spillway drain channel floor was noted at lower end.

Heavy seepage of water coming through toe of slope in area of outlet end of 20" pipe feeding lower reservoir was noted. However, this toe of slope is riprapred with large rock and water seepage could be local surface drainage rather than water from dam.

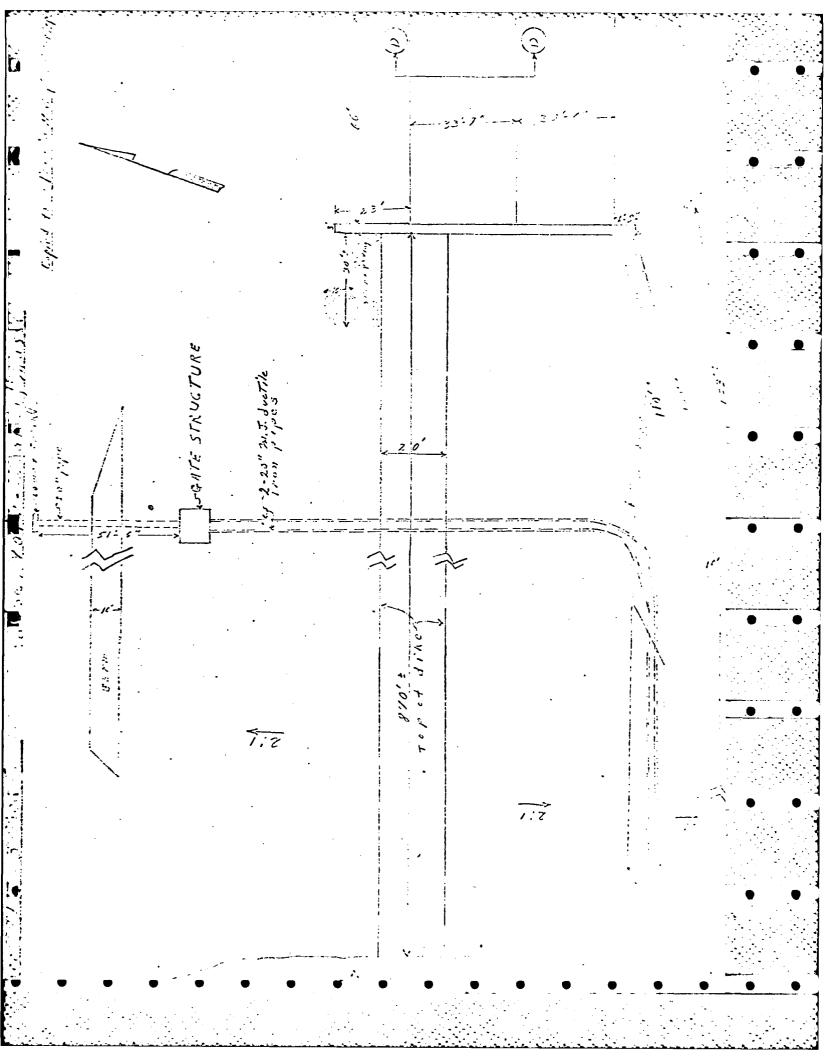
TOWN WHATELY

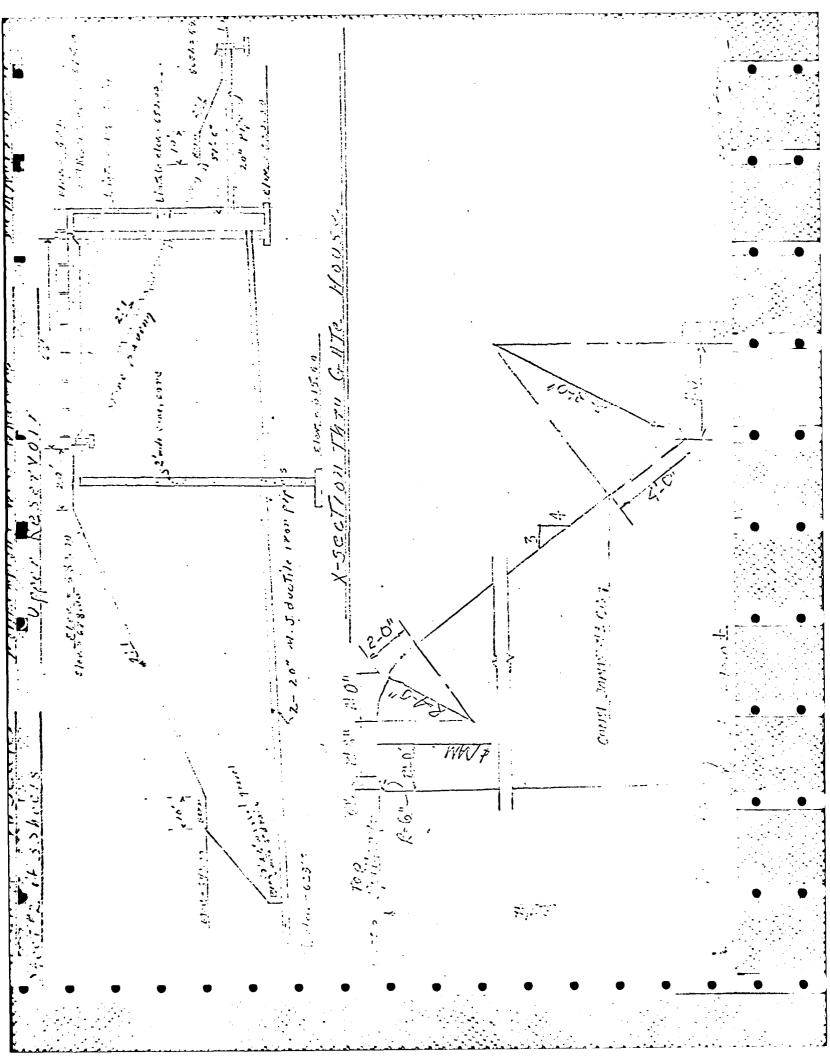
Name Northampton Heservoir #2	· Inspection Date 1970	
Owner City of Northampton		<u>-</u> -
Location Just upstream of #230		
Type of Pond		
Acreage		
Drainage Area		
Comments		
Type of Dam		
Length		
Height		
Head of Water		·:
Comments		
Type of Spillway		
Width		
Height		
Comments		
Condition, Previous Report, Dated		

Present Condition Being constructed

		DISTRICT II		
Submitted 1	by Harold T. Shumway	Dam No	-6-337-3	
Date <u>No</u>	vember 29. 1973	ELEST/Town	Whately	·····
		Name of Dam	Northamoton's V Reservoir - Upp	
Location:	Topo Sheet No. 11A	Mass. Rect. Coordinates N	27.600 E 2	279,900
	de $8\frac{1}{2}$ " x 11" in clear learly indicated.	copy of topo map with	location of	
On We	st Brook in West Whate	ely just above Lower F	eservoir, Number	: 2-6-337-2, c
	3/10 mile on Conway of Conway Road.	Road from Williamsburg	Road intersect	ion and just
Year built	1970	Year/s of subseque	nt repairs	
		X Recreati		
				······································
Orainage A	rea: <u>81</u>	sq. mi	acre	:s.
	City, Bus. & Ind.	sq. mi. Dense Res. X Slope: Steep 509	Suburban	Rural, Farm
Type:	City, Bus. & Ind	Dense Res.	Suburban	Rural,Farm_
Type:	City, Bus. & Ind. Wood & Scrub Land ding Area: 82 [±] Impoundment: 7	Dense Res. X Slope: Steep 50%	Suburban Med. 50% S th 28 1/10 2	Rural, Farm
Type: Normal Pond Silted No. and ty	City, Bus. & Ind. Wood & Scrub Land ding Area: 82 [±] Impoundment: 7 d in: Yes No	Dense Res. X Slope: Steep 50% Acres; Ave. Dep 50 million gals.;	Suburban Med. 50% th 28 1/10 2 2296 unt Storage Area reservoir	Rural, Farm
Type: Normal Pond Silted No. and typine. summe	City, Bus. & Ind. Wood & Scrub Land ding Area: 82 [±] Impoundment: 7 d in: Yes No	Dense Res. X Slope: Steep 50% Acres; Ave. Dep 50 million gals.; o X Approx. Amored adjacent to pond or 12.	Suburban Med. 50% Sth 28 1/10 2 2296 unt Storage Area reservoir th 60'± at time of inspe	Rural, Farm Slight acre ft.
Type: Normal Pond Silted No. and typine. summe	City, Bus. & Ind. Wood & Scrub Land ding Area: 82 [±] Impoundment: 7 din: Yes No pe of dwellings locator homes etc. Non of Dar: Length 870 Slopes: Up.	Dense Res. X Slope: Steep 50% Acres; Ave. Dep 50 million gals.; o X Approx. Amored adjacent to pond or 12.	Suburban Med. 50% The 28 1/10 29 2296 The 28 1/10 29 The 28 1/10 29	Rural, Farm Slight acre ft.

Classification of Dam by Material: Core Wall Earth X Conc. Masonry X Stone Masonry	- <u></u>
Timber Rockfill Other Stone paved slop	e upstream
Dam Type: Gravity X Straight X Curved, Arched Other Overflow Non-overflow X	
A. Description of present land usage downstream of dam:	
B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? Yes NoX	
C. Character Downstream Valley: Narrow X Wide Developed record Rural 100% Urban	ural homer
No. of people 10 No. of homes 10	
No. of businesses None	<u> </u>
No. of industries None Type Water, telephone and electric tr	rangmi sai o
No. of utilities 3 Type lines. Northampton Water Works.	
Railroads None Northampton's West Whately Reservoir - Lower Dam, No. Other dams 2 - E. S. Crafts Dam, No. 2-6-337-1	2-6-337-2.
Other 5 Town Highway Bridges and 3 Town Highways.	
Attach Sketch of dam to this form showing section and plan on $8\frac{1}{2}$ " x 11" sho	eet.
'sd ents	
s Plan	•

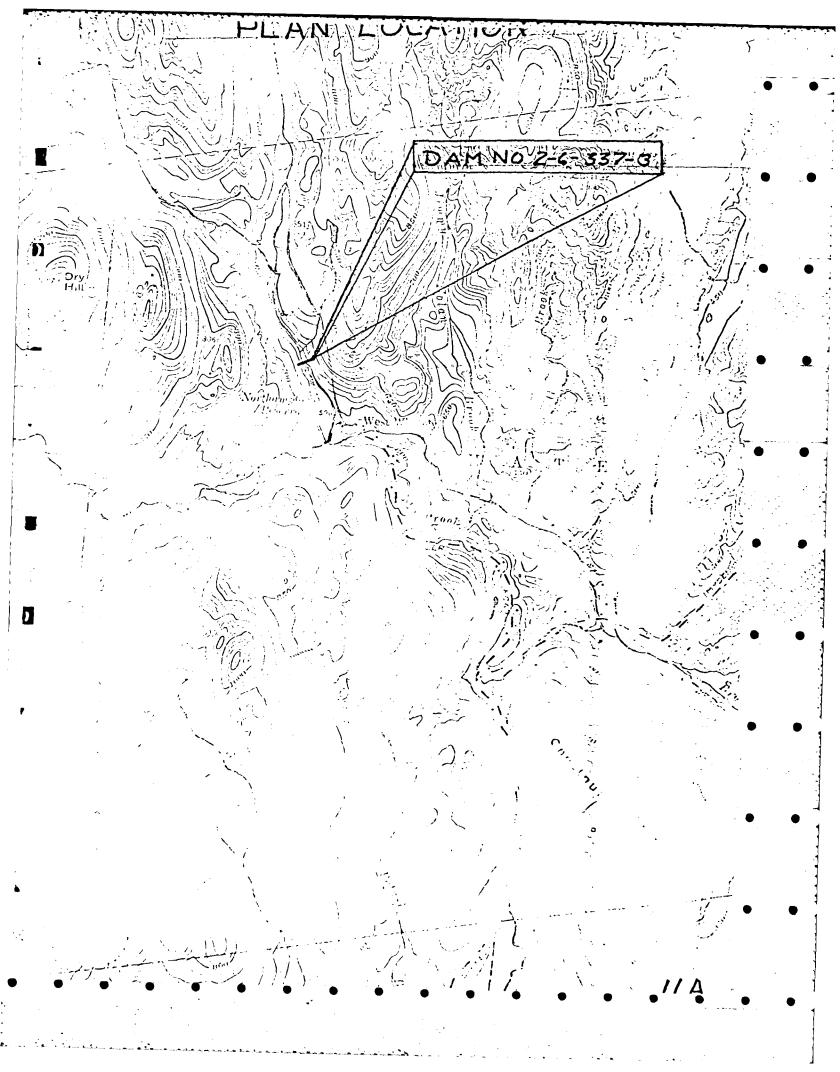


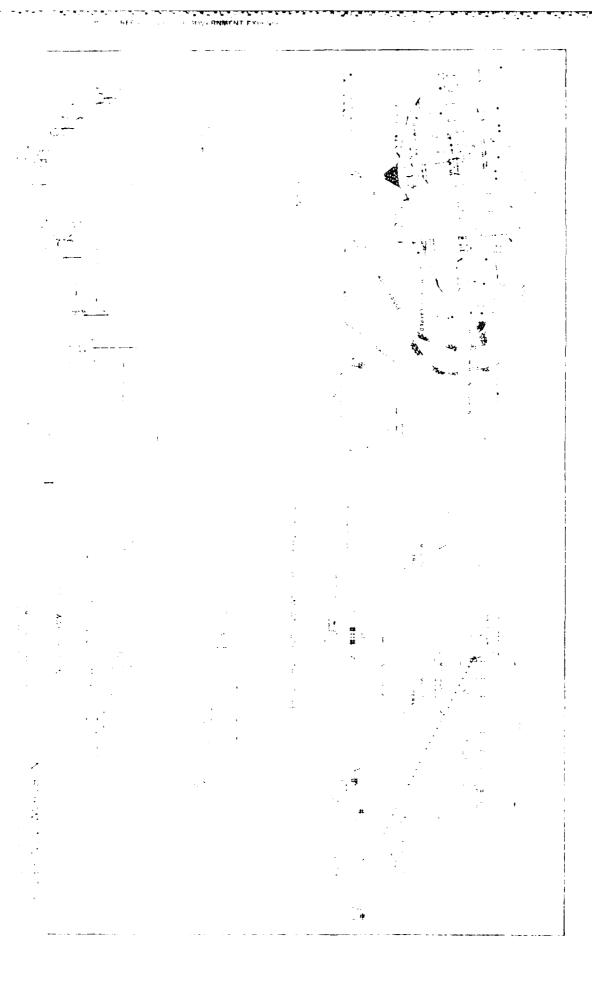


MALLESZIETZON Fillings 2" Guine VIR. -: -: S/8 FINCHOR ROLTS :=1-1.665.00 ELEV. 652.60 ¿ Elev. 650.00 Intole Gate Dischunge Bate \$2121 1:22.00

+33000

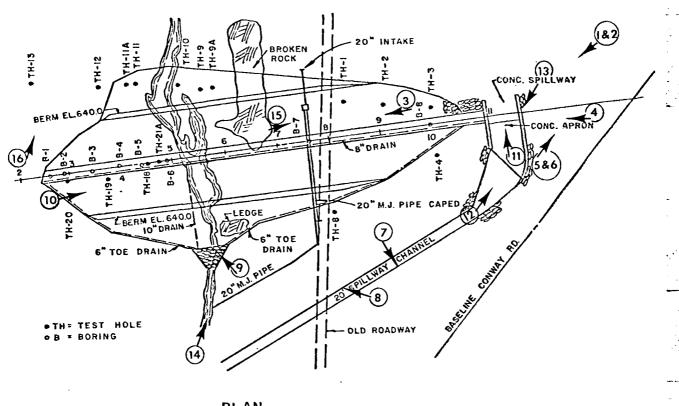
Gate Stanzing Con Flenation)





APPENDIX C

PHOTOGRAPHS



<u>PLAN</u>

LOCATION OF PHOTOGRAPHS
NORTHAMPTON RESERVOIR
UPPER DAM
IN
WHATELY MA.

NOT TO SCALE JULY 1978



 $\frac{\text{PHOTO NO. 1}}{\text{In Photo 2.}}$ - Close-up of surface erosion shown in Photo 2.

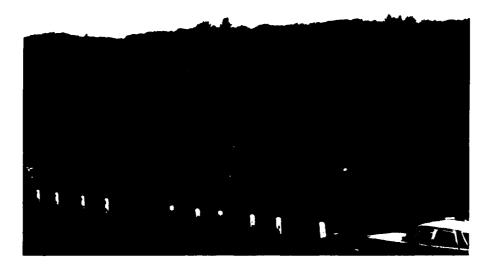


PHOTO NO. 2 - General view of surface erosion on left abutment along contact between u.s. face and abutment.

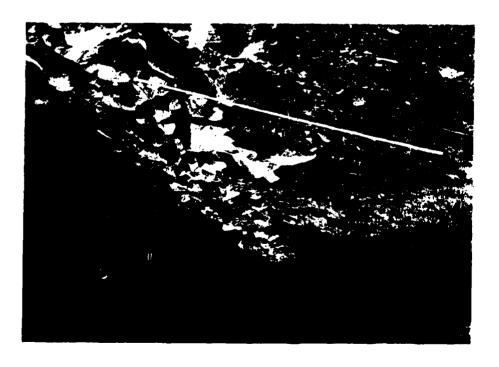


PHOTO NO. 3 - Upstream face showing riprap stopping about 3 ft. below crest of dam.



PHOTO NO. 4 - Area of surface slumping on d.s. face of dam near left abutment.

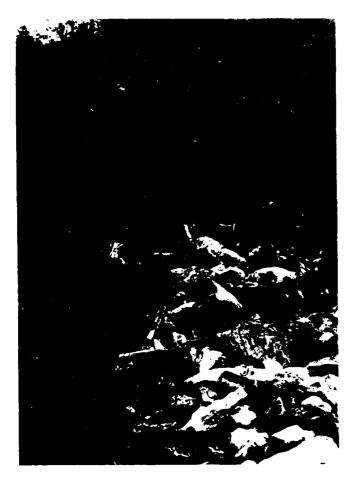


PHOTO NO. 5 - Channel of surface erosion on left abutment at contact of d.s. face and abutment.



PHOTO NO. 6 - Close-up
of surface erosion
channel shown in Photo 5.

PHOTO NO. 8 - Slide on right bank of spillway channel.



PHOTO NO. 7 - Slide on left bank of spillway channel.

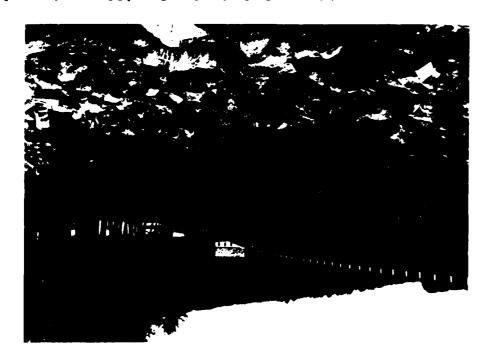




PHOTO NO. 9 - Outlets of
toe drains.

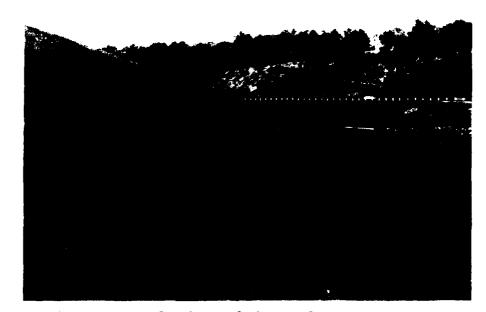


PHOTO NO. 10 - General view of d.s. slope from area of right abutment.



PHOTO NO. 11 - General view of spillway.

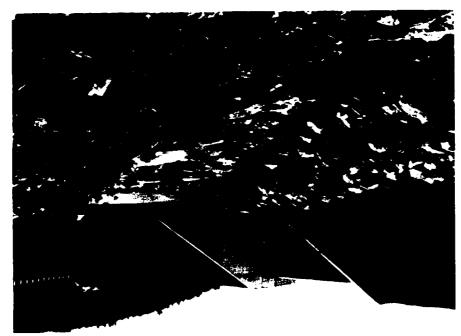


PHOTO NO. 12 - General view of spillway and outlet channel.



PHOTO NO. 13 - Spall where u.s. spillway wall abuts spillway.

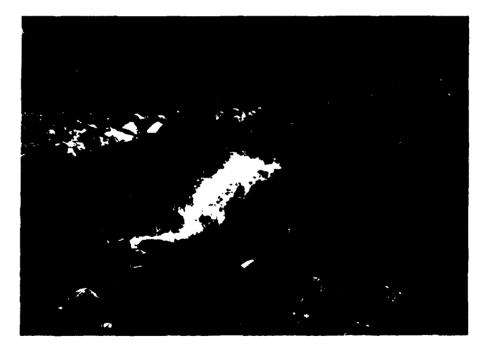
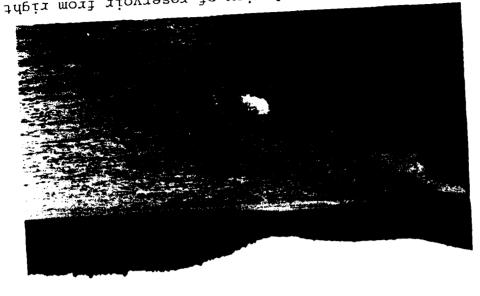
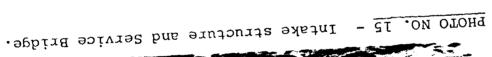


PHOTO NO. 14 - Outlet pipe at lower reservoir.

PHOTO NO. 16 - General view of reservoir from right abutment.







APPENDIX D

- 1. HYDROLOGIC COMPUTATION
- 2. DRAINAGE AREA

0

SUBJECT NOTTE Supply MAGG I There Mermal 2296 a-1. 11:14 27:00 a.f. Height Siza - internigacióta. Hazara high Dosign CAK PMF Whitman - Howard Drain Ared 2897 a co 4,53 sy mi Rolling to vin Arco 1875 cfs/s.mi. Q1 = F/r = 1875 × 4,53 = 8,500. cfs En lary (rec' pa) 2 Langth = 661 11+ C= 3.97 (King) ... 8000 = 29 (Ki) (H) 1/2 11/2 = 33,023 H= 10.3 ff. NO FRAL GUTT F WALLEY Caparing

BUBJECT Novel ham. Mostry ton - wipe 97 37 (60) (55) " = 3,220: 472 Q = remainder overflows drive 8500 3320= 5180 of $\frac{65}{12} = \frac{x}{100} = 4.17\%$ = 0.041/1. 364 4 10.12' (-0.5 10' conette dan Q=VF V= 198 12/3 51/2 E 10+ Y = 2' WP = 2.5+ 260+30.460 = 175'. 1= 9801×24 1012+ 65 = 27751 R= 2,26 1.78. V= 1.4-86 (1.78) (.2) = 13.23. Firs 2 G= 13,13 (2295)= 30203 > 5180 b let y=1' wp = 940? A= 980+2,5+150 = 1/33,5f. K = 1.205 V= 11/4 (1.13)(12) = 8.47 Fpc Q=893(11=1) = 9840 As >5180. $V = \frac{104}{100} = \frac{0.75}{100} = \frac$ Q=7.47 (9:3) = 6922 > 0180 10t - ICO 4 681.35 1 For a 1915

HAYDEN, HARDING & BUCHANAN, INL CONSULTING ENGINEERS BOSTON, MASSACHUSETTS SHEET NO. JOB JOB JOB JOB SHEET NO. JOB SHEE

57.71 56.51 Area 2 1.40 gim 12860. 530 ,04 Acon BROZ 58.69 .97 zim 89,10 Acre (60.53) 610 1.4 79 a. 0.86 37.5 /20' OF 9/FH 2. $\frac{Q}{1} = \frac{Q}{1} = \frac{Q-f}{decom}$,01 0.09 3.7. 300 710 71 72 630 0,6 5: 20. 29,4 588, 660. 697 89, 30. 72 2160 2820. 6:00 680 90. 0.8 815 18 2838 (20,2. 91 . 0.81 90.5 27 2865. 6-1.5 C 100 (101 a.f) 79. 6.25'. 85.0. 531. 1171 (675-5612) 615 (100 a.F) Trans = 531 at x 12 + 2897 = 2,20 " rund + (1- 8500 × (1- 82.20) = 7,500. c√s 11 1-13330 = 4,180,

 $y = .57 \quad axy = .920^{4} \quad F = .5(250) = .477 = .66$ $V = \frac{1419}{135} \cdot (.66)(.2) = 4.9 \quad Fy \leq .4.9 \quad 4.9 \quad 4.9$

HAYDEN, HARDING & BUCHANAN, INC.

CONSULTING ENGINEERS
BOSTON, MASSACHUSETTS

SUBJECT DE COLOR -U.

つ. 675.0 79 6 681.0 85 82,0 I- 2= 498 2-5 492+541 = 517# dr or 2.142" Gy = 8500 × (1-20142) = 7542. ets Chi flow over typ of dam = 7542cfs' due to osco topping, estimate du lailers Stages at time of radiate & 2865 a.T Rua stro at home of dans 600.000 or operate de la 1800 740. y = 81.35' $Q_{i} = \frac{8}{9} (300) \sqrt{37.7} (81.35)^{3/2} = 354.800$ 24 long dan Que = 3852 cfs

 $\frac{10.000 - 0.000}{4.754}$ $\frac{1.900 - 0.00}{5.368}$

For $4h \leq 0 \leq 601 - 20 = 604.00$ out the for $4h \leq 0 \leq 400$ $\frac{4}{3} = \frac{A}{100} \times \frac{A}$

HAYDEN, HARDING & BUCHANAN, INI

BUBJECT NOTTH IN 16

Storace in Pench 620 616 63.50 aus 1365 38,52 a الربيح تث 65.53 - 63,48 4,6 a. .05 610 600 0.20 1880, 18.34 NOV 1150 16 616 25.71 10 72 79 6 455 76 4 38 57 16 20 60 16 18 11 32 2 11 2 2 33.75 17. 1818 34, - 18 33.75 17. $Q_{12} = 452800 \cdot \left(1 - \frac{765}{3000}\right) = 338,535$: cfs Extens 2 For QP. Use elie 614 Vol= 488 af lot y= 40' G10 wp = 11,0+ 100 = 1210 A = 10,800 +5800 =16,100, K = 18.2 5.66 V= 14 861 - (5)= 16,83 Q= 271,000 ests < 338 14:

HAYDEN. HARDING & BUCHANAN. INC SHEET NO BUBLECT A LOT LANGE CO. CONSULTING ENGINEERS CLIENT _______ Tale fler due to poth dim I love. Q = 453,800, +s First geolian 600' below love din = 10' = 4% to 0.0411 N = 0.10. 12t y = 20' plas 590 wjs= 8501 A= 30 (16'x20') = 60-0 5f R= 7.06 3.7. V = 1.46 (3.7) (.2) = 11 fps Q= 65,972 + 45 K 458800 NG 100 y = 301 2 20 11 1 87 + 26: = 1/10. A = 6000 + ((100)+15 (100) = 1000 13 K= 9.3 ' 4.4= 14.22 (2.428) (= 18.12A-14 Q= -135181 efst & wind 1. 1 y = 50' 200 620 apr 1110 + 200 = 1316" A = 10300 + 27 (400) 21900 P = 16.7! 6.6. V= 14.86 (6.6)(.z) = 19.61. G= 429554 2 451800. 2 . 621 W. = 1320 Francisco Programme V = 10.5% (6.5)(.2); 2%C + 669 266 de 10 Just 2 600,5 3

HAYDEN, HARDING & BUCHANAN, INC. CONSULTING ENGINEERS BOSTON, MASSACHUSETTS

	1	6HEET	NC		.,
JOB	<u> </u>				
BUBJECT	1.2.		1	T /// -	(_,
CLIENT _	C : -	, :	7		_

Vol Aux = 483 +763 = 561 0-9	,
GHz = 4-3800 (1- 3000) = 359,00	1º . cfs
000 76+00 A+ elu-	G20.5
Next Evelou 4.600' holo eld dam	
$C = \frac{570.410}{4000} = \frac{120}{4000} = 370 = 0.0311$	<i>प ७</i> ₹
n= 0.10 Cin 253,40	0.095
1- y= 90 Jun 470	

4 488

1

HAYDEN, HARDING & BUCHANAN INC CONSULTING ENGINEERS BOSTON MASSACHUSETTS

JOB DOWS

BUBJECT DOWN CONTES

a 26+0 Laton lower day Gin = 559,000 cfs $C = \frac{570 - 512}{2600} = \frac{58}{2600} = \frac{5}{2600} = \frac{5}{2} = \frac{2}{2} = \frac{$ 1.7 y= 42' ela 550 W/1= 4151 A = 23(400) = 9200 sf R = 22.19. 7.97. V = 14.26(7.97)(.1492) = 17.69.Q= 162,711. cr= = 369 rgd 18 y = 52' since 560 ωρ: 455'

A = 920 1 × (201) = 1240'

K = 26.46 9 0 0 0 0

/ = 21.397 ·

Q = 286732, 4 mg/ 1st Y=62 dem = 10 4) = 495 A = 13400+24(200) = 18200 $72 = 36.77 \cdot 11.19$ V = 24.83Q- 451,869 > regid. dus 568

A = (1820 - 1340)(8) = 11840 = 17240

12 1 1 (40 (200)) = 920 and L. 2(3000) of

HAYDEN, HARDING & BUCHANAN CONSULTING ENGINEERS

17

JOB Dawy

SUBJECT No. That PTN - CLIENT Co. JC.

 $C_{V_{0}} = 359,000 \times \left(1.69929 \atop 3000\right) = 2.48,000 \pm 45$ $A = 13400 - 400 \times 13000 \text{ of}$ $Vol = 13000 + 27720 \times 2000 \times 43550 = 832. \text{ of}$ $Q_{V_{0}} = 359,000 \times \left(1-\frac{706881}{3000}\right) = 253,454 \pm 0.0$ $G_{V_{0}} = 359,000 \times \left(1-\frac{706881}{3000}\right) = 253,454 \pm 0.0$

HAYDEN, HARDING & BUCHANAN INC CONSULTING ENGINEERS BOSTON MASSACHUSETTS

SUBJECT Day 1 12 To 1 Couple

 $G_{F2} = 253,400 \cdot \left(1 - \frac{196708 + 519}{3000}\right) = 201,4-53 \pm cf_{2}$ $V_{0} I = \frac{93004 + 13600}{2} \left(\frac{2000}{45560}\right) = 519 \cdot 4 - f$

Gent 201,400 de Celu 488±.

10 66-00 Qu = 201,400,000 = 20

Ex 450-40% 2,25% or 0,0225 1/1

1 4 4 40' El 445

A = 29(400) = 157,02

(F. 26) 6.87. V= 16.8 (8+7)(15) = 19.77. first Q= 308401 > 19.4 64 y= 30 1/1 435

64- 530 A = 15.27 - 16 (20) = 10,000 15,5 HAYDEN, HARDING & BU CONSULTING ENG BOSTON, MASSAC

JOB VALLES

BUBJECT COLDS

66+00

438. 7 9= 201,400, FS

N = 15600 - 28(1254) = 12,100 = 5 $V_{1} = \frac{12100 + 13600}{2} \left(\frac{2000}{42560}\right) = 590 = 5$

 $G_{i} = 201,400 \left(\frac{42560}{3000} \right) = 161,700. \pm c.6s$

3000) 4-37.5 ±

A: 11400, A 1

16, = 1140 +18600 (.00x9) = 5 74.4-5

V, = (57+ + 590) * = 5824-1

 $= 201,400, (1-\frac{582}{3000}) = 162,300^{\frac{1}{2}} f_{5}$

Elcir 438.

Sta 79400 Jus 162,300 de elso 315 $= \frac{405.375}{1300} = \frac{30}{1300} = 2.3.\% \quad 0.0737$ 154 Y= 40' 2/05 415 4 = 1.10 w/2 = 970' A = 51 (410) = 22,800. 34. A = 73,54. 8.20. V = 19.84 (8.79)(.1516.) = 18.68. C = 475,963. A = 14.68.150 Y= 251 Sun 400 10 = 876 10 = 10800 - 34 (15x20) = 11,100 of 7 = 12.70 5.51-V = 12.4 Q= 137,698' < rug 1 let Y= 30 Su 405 W/ = 900 A = 11100+ 35 = 15,000 V = 16.67 6.59. V = 14,04. D = 277560> 14 2777602 ryd

Sin 402 "

A = 72720 +

 $V = \frac{12720 \cdot 12100}{2} \left(\frac{13000}{43540} \right) = 370 \, d-f$

elio 401

A = 13860 - 25 (38×71) = 11960

Var 359+370 = 365 a-f

 $CD_{-3} = 162,300 \left(1-\frac{80365}{3000}\right) = 142,564.65$

Scalble dange to 15 mass + 9 other

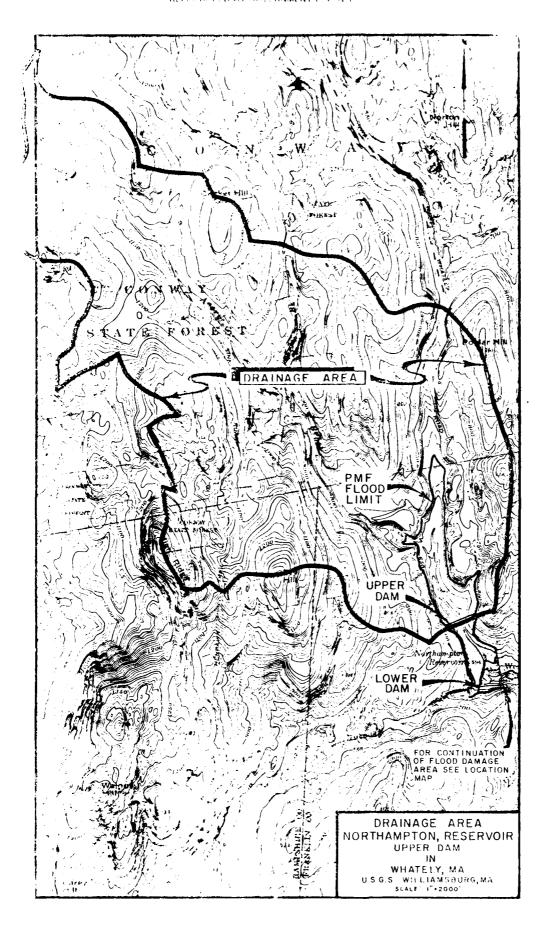
Gre = 162300 (1-87) = 14-2,400. 650

V = 12100+1960 (1300) = 359 d.1

structures

HH &B HAYDEN, HARDING & BUCHANAN, INC CONSULTING ENGINEERS BOSTON, MASSACHUSETTS INSpl. 1 Dr Cor -Ross 402. 1 この下下ACE 8000 438 0061 0099 9000 上田上マン 488 DISTANCE 17295 0006+ 568, 0092 STREAM
BOTTOM 2000 .029 009 MYM COMER MAN 0 在是一个门。 ζ. . 0 950 400

BY FED	HH &B	HAYDEN, HARDING	G & BUCHANAN G ENGINEERS MASSACHUSETTS	. INC	JOB	1	NO _/	•
	CTAGE_	UT JAKE	- 14C	HAFGI				
	SEL TOP BANK			2.5 mm 25.5 mm 25.7 mm	5000 Saco Faco 4000 C	57cm 462 - 4-F		



APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

開記 INVENTORY OF DAMS IN THE UNITED STATES

d

PAGE	AND	MONOD TO THE PROPERTY OF THE P	BOILTING I			
######################################	ACT	COMIT DIST SIME COUNTY DIST.		(WEST) DAY MO Y		
NAME OF MARE OF MARCHIA NAME OF MARCHIA NA	STREAM NORTHAMPTON & ESERVOIR UPPER	1 OI LOSTANTON DE DE	TACO THE CONTRACTORY	7241.2	• ·	
NORTHAMPTON KESERVOIR JPPER NORTHAMPTON KESERJON KESE	3	POPULA	NAME OF IMPOUNDMEN	178		
DISTREMA NEARSTIONWISTRAM NEARSTIONWISTRAM POULATION	DR STREAM NHATELY DWN -VILLAGE FROM I PAULATION DR STREAM FED M	T MMATELY	PION RESERVOIR UP	الم أ		
08 STREAM	08 STREAM NEAREST DOWNSTREAM FROM POPULATION CITY—TOWN -VILLAGE FOLIATION POPULATION CITY—TOWN -VILLAGE FOLIATION FED N N N N N N N N N N N N N N N N N N N		9			
### PURPOSES ##################################	### PURPOSES ###################################	RIVER	MEAREST DOWNSTREAM CITY-TOWN-VILLAGE			
### PURPOSES ###################################	PURPOSES	*EST	MMATELY			
90 80 2020 2460 NED N N N N N N N N N N N N N N N N N N	S 90 80 2020 2460 NED N N N SEMANS NOTED N N N N N N N N N N N N N N N N N N N	(a) (a)	(a)			
S 90 80 2020 2460 NED N N N N N N N N N	### ##################################	COMPLETED PURPOSES	HYORAU MPOUNDING CAPACITIES HEIGHT WAXINGW	IST ORN FED B	3	VER/D
REMARKS REMARKS REMARKS REMARKS RECOURT RESERVE CAPACITY SAZO REGULATORY AGENCY RE	REMARKS POWER CAPACITY FYANCE OCY) BEGULATORY AGENCY BEGULATORY AGENCY BY REGULATORY AGENCY REG	1970 8	80 2620 2460	z		24JUL
THEMARKS THEMAR	### POWER CAPACITY ### OF COMSTRUCTION ###################################		•			
SAZO MATTHAN AND HOLARD, INC. SHAMAN INC. SHAMAN INC. SHAMAN INC. SHAMAN SERVING TO SHAMAN SERVING SERVIN	S320 SONSTRUCTION CONSTRUCTION CONSTRUCTI		MARKS			
FOURTHUCTION STATES THE GULATORY AGENCY THE GULA	FREGULATORY AGENCY SOLOMSTRUCTION SOLOMSTRU					
ENGINEERING BY	BY INSPECTION OF A NUTHORIT	CINDM CINDM CINDM COLUMB COLUMB	ED TENGTH WIDE	NAVIGATION LOCKS	9	
OWNER ENGINEERING BY MHITHAN AND MCMARD, INC. MEGULATORY AGENCY DESIGN MINSPECTION BY OAY IND YR AUTHORITY FOR IN	OWNER ENGINEERING BY OF NCHTHAMPTON MHITMAN AND MCMARD, INC. DESIGN DESIGN CONSTRUCTION MREGULATORY AGENCY DESIGN DESIGN DESIGN DESIGN DOPERATION MSPECTION BY DAY IND DAY IND ON DAY IND ON DAY IND ON DAY IND ON ON ON ON ON ON ON ON ON	3320	(14)			
CITY OF NCHTHAMPTON AMITMAN AND MCMARD, INC. *** ********************************	OF NCATHAMPTON MITMAN AND HCMAND, INC. PREGULATORY AGENCY DESIGN B REGULATORY AGENCY OPERATION B NSPECTION BY OAY ING VAITHORITY FOR IN	•		(•		
REGULATORY AGENCY DESIGN DEFRATION DAY INC. ZOMAY76 PL 92-367	OF NCHTHAMPTON REGULATORY AGENCY DESIGN DOPERATION DOAY INSPECTION BY DOAY IND THE CONSTRUCTION BY THE CONS			CTION BY		
REGULATORY AGENCY DESIGN CONSTRUCTION INSPECTION DATE AUTHORITY FOR INITIAL SOME AUTHORITY FOR INI	DESIGN CONSTRUCTION OFFICIAL OFFICIAL OFFICI	SANTILE SOUTERINGS NO	HOMAND,			
REGULATORY AGENCY DESIGN DESI	DESIGN CONSTRUCTION OPERATION B			(0)		
DESIGN DESIGN DINSPECTION DAY IND AUTHORITY FOR IN REMAND REMAND B B B B B B B B B B B B B	DESIGN CONSTRUCTION OPERATION INSPECTION BY DAY IN YAR AUTHORITY FOR IN		! !			
INSPECTION BY DAY IND YR AAYDEN, MARDING + BUCHAMAN INC. REMARKS	INSPECTION BY DATE	CONSTRUCT	i 1	MAINTENANCE		
INSPECTION BY INSPECTION BY ONY INDIVIDUAL BUCHANAN INC. 26MAY76 PL 92=34	INSPECTION BY DAY ON YR	i				
INSPECTION BY INSPECTION BY DAY IND YR AND YR SOMAY TO PL 92=34	BY DAY MO YR					
HAYDEN, HARDING + BUCHANAN INC. SOMAY76 PL 9		. ₩		NSPECTION		
ORGANISA STATES OF THE PROPERTY OF THE PROPERT	TAYDEN, HARDING + BUCHANAN INC. ZOMAY76 PL 9	NAME THE PROCHESS INC.	6 7d 97.4m9			
			•			
OCCUPATION OF THE PROPERTY OF	PREFERENCE		#ARKS			

END

FILMED

7-85

DTIC